

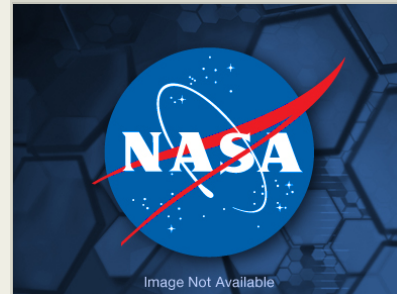
High Resolution Energetic X-ray Imager (HREXI)

Completed Technology Project (2012 - 2016)



Project Introduction

We propose to design and build the first imaging hard X-ray detector system that incorporates 3D stacking of closely packed detector readouts in finely-spaced imaging arrays with their required data processing and control electronics. In virtually all imaging astronomical detectors, detector readout is done with 'flex connectors' or connections that are not 'vertical' but rather 'horizontal', requiring loss of focal plane area. For high resolution pixel detectors needed for high speed event-based X-ray imaging, from low energy applications (CMOS) with focusing X-ray telescopes, to hard X-ray applications with pixelated CZT for large area coded aperture telescopes, this new detector development offers great promise. We propose to extend our previous and current APRA supported ProtoEXIST program that has developed the first large area imaging CZT detectors and demonstrated their astrophysical capabilities on two successful balloon flight to a next generation High Resolution Energetic X-ray Imager (HREXI), which would incorporate microvia technology for the first time to connect the readout ASIC on each CZT crystal directly to its control and data processing system. This 3-dimensional stacking of detector and readout/control system means that large area ($>2\text{m}^2$) imaging detector planes for a High Resolution Wide-field hard X-ray telescope can be built with initially greatly reduced detector gaps and ultimately with no gaps. This increases detector area, efficiency, and simplicity of detector integration. Thus higher sensitivity wide-field imagers will be possible at lower cost. HREXI will enable a post-Swift NASA mission such as the EREXS concept proposed to PCOS to be conducted as a future MIDEX mission. This mission would conduct a high resolution (<2 arcmin), broad band (5 – 200 keV) hard X-ray survey of black holes on all scales with $\sim 10\text{X}$ higher sensitivity than Swift. In the current era of Time Domain Astrophysics, such a survey capability, in conjunction with a nIR telescope in space, will enable GRBs to be used as probes of the formation of the first stars and structure in the Universe. HREXI on its own, with broad bandwidth and high spectral and spatial resolution, will extend both Galactic surveys for obscured young supernova remnants (^{44}Ti sources) and for transients, black holes and flaring AGN and TDEs well at greatly increased sensitivity and spatial/spectral resolution than has been done with Swift or INTEGRAL. If the HREXI-1 technology is developed in the first year of this proposed effort, it could be used on the upcoming Brazil-US MIRAX telescope on the Lattas satellite, scheduled for a 2018 launch with imaging detector planes to be provided (under contract) by our group. Finally, the 3D stacking technology development proposed here for imaging detector arrays has broad application to Wide Field soft X-ray imaging, to CMB polarization mode (B mode) imaging detectors with very high detector-pixel count, and to Homeland Security.



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Organizational Responsibility

Responsible Mission Directorate:

Science Mission Directorate (SMD)

Responsible Program:

Astrophysics Research and Analysis

Project Management

Program Director:

Michael A Garcia

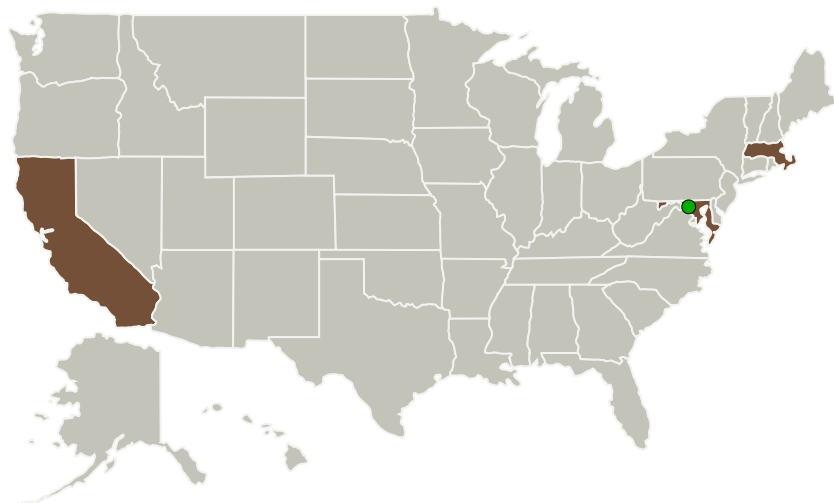
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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
California Institute of Technology(CalTech)	Supporting Organization	Academia	Pasadena, California
 Goddard Space Flight Center(GSFC)	Supporting Organization	NASA Center	Greenbelt, Maryland
Harvard College Observatory	Supporting Organization	Academia	Cambridge, Massachusetts
Harvard University	Supporting Organization	Academia	Petersham, Massachusetts

Primary U.S. Work Locations	
California	Maryland
Massachusetts	

Project Management
(cont.)**Program Manager:**

Dominic J Benford

Principal Investigator:

Jonathan E Grindlay

Co-Investigators:

Jae Sub Hong
 Branden T Allen
 Fiona A Harrison
 Denise Lentini
 Scott D Barthelmy

Technology Areas

Primary:

- TX08 Sensors and Instruments
 - TX08.1 Remote Sensing Instruments/Sensors
 - TX08.1.1 Detectors and Focal Planes

Target Destination

Outside the Solar System